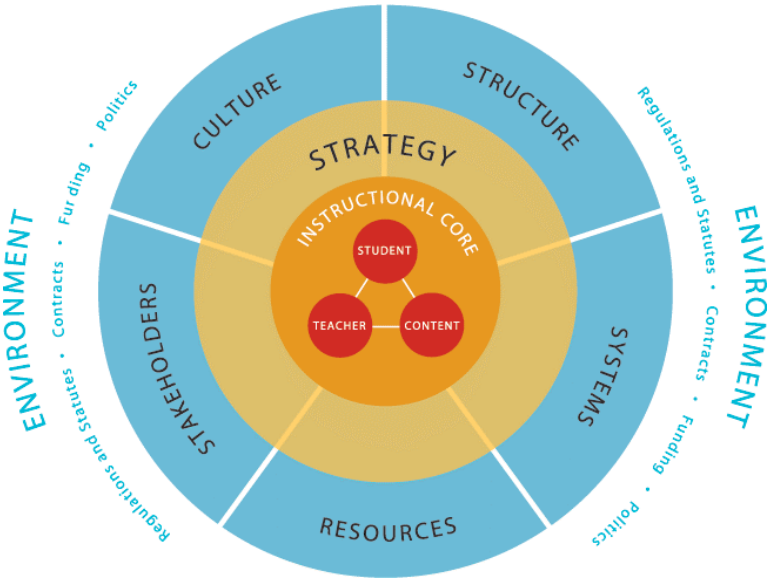
Characteristics of High Quality Teaching and Learning in Kentucky Schools

This document is an effort to describe the roles of the teacher and student in an exemplary science/mathematics instructional environment. The focus of the document is on the "instructional core" at the center of the educational process as described in detail in the *Public Education Leadership Program (PELP)* www.hbs.edu/pelp. Future documents will address the "outer ring" factors that are present in science classrooms in high achieving schools and districts – essential resources for science programs, stakeholder involvement, the learning culture, structures and system components, including sustained high quality professional learning opportunities for teachers who are at the core of the instructional process.

PELP Coherence Framework



Note: The research document citations present in the original version have been removed for the purpose of focusing on the characteristics statements themselves. These documents, based on research, articulate the vision for high quality science instruction and have also served as the basis for additional and more current research. Therefore, they should be considered in their entirety as the underlying basis for all of the topics listed.

- **National Research Council (NRC). (1996). *National Science Education Standards*. Washington, DC: National Academy Press.**

- **National Research Council (NRC). (2000). *Inquiry and the National Science Education Standards*. Washington, DC: National Academy Press**
- **National Research Council (NRC). (2001). *Classroom Assessment and the National Science Standards.* Washington, DC: National Academy Press**

In addition, the following state documents provide the framework and guidance for all science instruction in Kentucky:

- **Program of Studies, Revised 2006**
- **Academic Expectations**
- **Core Content for Assessment, Version 4.1**

Mathematics

1. Knowledge of Content

The teacher:

- A. Demonstrates an understanding of all pedagogical mathematics content and an ability to convey this content to students
- B. Keeps abreast of current developments in mathematics
- C. Designs standards-based courses/lessons/units using Kentucky's Program of Studies Revised 2006, Academic Expectations, and Core Content for Assessment Version 4.1
- D. Demonstrates that mathematical understandings are outcomes of solving meaningful problems rather than merely of procedural instruction
- E. Encourages students to analyze mathematics by identifying the underlying procedures, applying mathematical knowledge, and making generalizations
- F. Uses and promotes the understanding of appropriate mathematics vocabulary
- G. Provides essential supports for students in mathematics who are learning English or have limited English proficiency

The student:

- H. Uses and seeks to understand appropriate mathematics vocabulary
- I. Connects mathematical ideas in different content strands, e.g., number and data, and in different content areas, e.g., science
- J. Uses mathematical ideas in realistic problems

2. Instructional Rigor and Student Engagement

The teacher:

- A. Teaches the complex processes, concepts and principles contained in the Kentucky Core Content for Mathematics Version 4.1 and the Program of Studies Revised 2006 using differentiated strategies that make them accessible to all students

- B. Scaffolds instruction to help students reason and solve cognitively challenging mathematical tasks that provide insights into the structure of mathematics or strategies for solving problems

- C. Orchestrates effective classroom discussions, questioning, and learning tasks that promote higher-order thinking skills

- D. Challenges students to think deeply about problems and encourages/models a variety of approaches to a solution

- E. Creates multiple opportunities for students to communicate and connect mathematical ideas through appropriate representations such as diagrams or pictures, examples, demonstrations, manipulative models, writing, symbols, and logical arguments

- F. Frequently and consistently demonstrates proficiency with the use of appropriate tools and technology to solve problems
    - Provides to students appropriate tools, such as pattern blocks, algebra tiles, calculators, rulers, reference materials, and computers, so that they can make sense of tasks
    - Appropriately integrates technology as a tool (e.g., graphing calculators, CBLs and probes for data collection, spreadsheets, problem-solving software)

- G. Integrates a variety of learning resources with classroom instruction to increase learning options for all students; these should include guest presenters, field experiences, and career exploration

- H. Makes clarifications and shares with students learning intentions/targets and criteria for success

The student:

- I. Articulates learning intentions/targets and criteria for success

- J. Justifies solutions to problems by communicating mathematically using written, hands-on, spoken and symbolic representations

- K. Uses mathematics and technology appropriately in problem solving situations (e.g. spreadsheets, symbolic manipulation software, graphing technology,

geometry software, simulations, formulas, etc.)

- L. Engages in active, hands-on, open-ended, problem-based learning experiences using meaningful mathematics that also reveal the structure of the mathematics

- M. Solves realistic problems using a variety of strategies

- N. Applies and refines inquiry skills by:
  - a. asking and identifying questions and concepts to guide problem solving investigations
  - b. designing and conducting problem solving investigations
  - c. using appropriate technology and mathematics to enhance problem solving investigations (graphing calculators, spreadsheets)
  - d. formulating and revising explanation and models
  - e. analyzing alternative explanation and models
  - f. collaborating with other mathematicians/students
  - g. accurately and effectively communicating results and responding appropriately to critical comments
  - h. generating additional testable questions

3. Instructional Relevance

The teacher:

- A. Designs lessons that allow students to participate in empowering activities in which they understand that learning is a process and mistakes are a natural part of the learning

- B. Incorporates student experiences, interests, and real-life situations in instruction

- C. Links mathematics concepts and key ideas to students' prior learning experiences and understandings, using multiple representations, examples and explanations

- D. Teaches students to express their understanding of how big ideas in mathematics are connected (e.g., through use of benchmark problems such as area and multiplication, data and numbers)

- E. Works with other teachers to make connections between and among disciplines to show how mathematics is a part of other major subjects

- F. Effectively incorporates technology that prepares students to meet future challenges, as articulated in the **Partnership for 21st Century Skills.**

The student:

- G. Responds to and poses non-trivial questions
- H. Expresses understanding of mathematics and how to apply it to problem-solving activities by creating responses to a variety of classroom activities and compiling their work in a form that they can access and use, e.g., mathematics journal, open-response item portfolio, entry and exit slips folder, 3-ring binder of problem solving experiences
- I. Uses appropriate tools and techniques to gather, analyze, and interpret data
- J. Uses multiple representations (e.g., words, numbers, charts, models, graphs, symbols, tables, diagrams, and manipulatives) to communicate mathematically and to uncover different aspects of the problem
- K. Works on mathematics that is connected to other content areas and to realistic problems
- L. Works collaboratively to address complex, authentic problems which require innovative and/or creative approaches to solve
- M. Communicates mathematics concepts in a variety of real-world forms (e.g., multimedia, transactive writing, computer modeling, etc.)
- N. Communicates mathematics concepts for a variety of purposes (e.g., facilitating collaboration, persuasion, dissemination of information, formative & summative assessment, etc.)

4. Learning Climate

The teacher:

- A. Creates learning environments where students are active participants in creating, questioning, sharing, discussing, and analyzing mathematical problems/ tasks.
- B. Motivates students to achieve, and nurtures their desire to learn in an environment that promotes empathy, compassion, and mutual respect among students and between students and the teacher
- C. Provides learning experiences that actively engage students as individuals and as members of collaborative groups (vs. merely compliant)
- D. Encourages students to accept responsibility for their own learning and respects the right of each student to ask questions and to request resources in order to more fully understand, enhance, or add clarity to the learning
- E. Displays effective and efficient classroom management (e.g., in facilitating cooperative groups, in use of equipment or hands-on materials)
- F. Provides sufficient time in mathematics class for students to engage in hands-on experiences, discussions of the content, applications of the mathematics, etc.

The student:

- G. Accepts responsibility for his/her own learning
- H. Actively participates and is authentically engaged (vs. merely compliant)
- I. Collaborates/teams with other students
- J. Exhibits a sense of accomplishment and confidence
- K. Takes educational risks in class (e.g., to refute, defend, etc.)

5. Classroom Assessment and Reflection

The teacher:

- A. Uses multiple methods within the classroom and systematically gathers data about student understanding and ability (formative and summative assessments)
- B. Uses student work/data, observations of instruction, assignments and interactions with colleagues to reflect on and improve teaching practice consistently
- C. Revises instructional strategies based upon analysis of student achievement data (short term and long term)
- D. Uncovers students' prior knowledge about the concepts to be addressed and addresses misconceptions/incomplete conceptions
- E. Co-develops scoring guides/rubrics with students and provides adequate modeling to make clear the expectations for quality performance
- F. Applies rubrics to assess their performance and to identify improvement strategies
- G. Provides regular and timely feedback to students and parents (focused, descriptive, qualitative) that moves learners forward
- H. Allows students to use feedback to improve their work before a grade is assigned.
- I. Facilitates students in self- and peer-assessment
- J. Reflects on work and makes adjustments as learning occurs

The student:

- K. Recognizes what proficient work looks like and determines steps necessary for improving his/her work, e.g., explaining, verifying, justifying.
- L. Develops and/or uses scoring guides periodically to assess his/her own work or that of peers
- M. Uses teacher feedback to improve his/her work
- N. Reflects on work and makes adjustments as learning occurs

Additional Resources

Kentucky Department of Education *Program of Studies, Revised 2006*
Kentucky Department of Education Academic Expectations
Kentucky Department of Education *Core Content for Assessment, Version 4.1*
Kentucky Department of Education *Standards and Indicators for School Improvement*
Kentucky Department of Education *Guide for Reflective Classroom Practices: A Self-Assessment Tool for Teachers* (draft)
Kentucky Department of Education Mathematics *PERKS*
The Mathematics Program Improvement Review: A Comprehensive Evaluation for K-12 Schools-ARSI-Ron Pelfrey
Standards-Based School Mathematics Review-ARSI/AMSP-Sheila Vice